

THE *Bulletin Mensuel* of the Zi-ka-Wei Observatory (near Shanghai) contains a discussion of the monsoons of the Yang-tse-Kiang from the observations at the stations of the maritime customs established from the entrance of that river as far as Hankow. The results are given in the form of wind-stars, which show that at the mouth of the river the influence of the two monsoons is sharply marked: the winter monsoon blows from between north-west and north-east, the north-west winds being most prevalent, while the summer monsoon blows from between south and south-east. After leaving the mouth the distinction is not so plainly marked; the prevalent winds tend more to the north-east in winter, and in summer more to the east and even north-east.

THE new Russian *Meteorologicheskii Sbornik*, published by the Russian Academy of Sciences, to the first volume of which we referred the other day (p. 183), contains Russian translations and Russian originals of papers published in German and French in vol. xiii. of the *Repertorium für Meteorologie*. The two publications will be parallel, under the Director of the Central Observatory, H. Wild.

IN a report to the Foreign Office, recently published, Colonel Stewart, the British Consul-General at Tabreez, calls attention to the curious system of lakes in that region, situated at a great elevation above the sea-level. These are the lake of Urumia, situated 4100 feet above the sea, Lake Van, and the Guektcha lake. Lake Van is in Turkish territory and the Guektcha lake in Russian territory, though both are near the bottom of the Persian province of Azarbaijan, in which is situated the lake of Urumia, the largest and most important. It is 84 miles long and 24 miles broad, and is probably the saltiest piece of water on earth, being much saltier than the Dead Sea. The water contains nearly 22 per cent. of salt. Its northern coasts are encrusted with a border of salt glittering white in the sun. It is said that no living thing can survive in it, but a very small species of jelly-fish does exist in its waters. Many streams pour down from the Kurdish mountains which border Turkey, and render the country between them and the lake of Urumia very green and fertile. This part of the country looks more like India than Persia, but the climate is severe in winter. The whole country being situated from 4000 feet to 5000 feet above ocean level, the snowfall in winter is great. At night in winter the thermometer falls frequently below zero of Fahrenheit, but in the day-time it rises considerably, generally reaching 28° or 30°, and this with a bright sun overhead. Many people are frozen to death on the roads in winter while crossing the various passes. The winter climate may be compared to that of Canada, but the summer approaches that of Northern India.

THE area under the administration of the Bengal Forest Department, according to its last Report, during 1889-90 consisted of 5195 square miles of reserved forest, 2239 square miles of protected forests, and 4034 square miles of unclassed State forest and waste lands, aggregating 11,468 square miles, which is 5½ per cent. of the total area of the province, viz. 193,198 square miles. The forests are, however, confined to the districts bordering on the sea, the sub-Himalayan tracts and the plateau of Central India, so far as it stretches into Chota Nagpore and Orissa. An area of 207 square miles was added to the reserves during the past year, and 25 square miles of protected forests in the Sunderbunds were farmed out for reclamation. The title of Government to existing reserves is being completed by a compliance with the requirements of the Act, and the inquiries incidental to these proceedings will also secure the record and protection of private easements. The special measures taken for the protection of forests from fires

have been increasingly successful, 95 per cent. of the areas thus dealt with having escaped, in spite of the dryness of the season, against 72.9 per cent. in the previous year. The financial results of the past year show a net surplus of Rs. 3,78,454, against Rs. 3,08,738 in 1888-89.

TOADS have been observed by some persons to feed willingly on bees and even wasps; and M. Hiron-Royer, who has noticed the fact, says that *Hyla versicolor* is positively frantic about wasps. He has seen one prefer them to every other kind of food, and devour them eagerly, although the stinging does sometimes bring the creature to temporary grief.

ONE of the last volumes of the *Mémoires* of the Kazan Naturalists (vol. xxii. 5) contains a most valuable work by P. Krotoff and A. Netchaieff, upon the geology of the Kama region, being the first part of a general description of that region which the Society intends to publish. The oldest geological formation of the region is that succession of red and grey sandstones and limestones, as well as of "variegated marls," which is considered as Permian by the Kazan geologists, and Triassic by other Russian explorers. The chief interest of the Lower Kama region is, however, in its Post-Pliocene deposits. They cover nearly the whole of the territory, and belong to two different series: the yellow loess-like sandy clays—containing the usual terrestrial shells (*Helix*, *Pupa*, *Succinea*, *Limnaeus*, *Pisidium*, &c.), together with bones of Mammoth and Rhinoceros—and the Caspian deposits. The latter attain a quite unexpected development, as they are found in all the valleys, thus bearing unmistakable evidence of the former extension of gulfs of the Caspian Sea up the valley of the Kama (almost as far as its junction with the Vyatka) and its tributaries. Deposits, containing the undoubtedly Caspian species of *Adacna plicata*, *Cardium edule*, *Dreissena polymorpha*, and *Valvata piscinalis*, as well as teeth of fishes, reach the heights of from 530 to 540 feet above the sea-level; and their presence has been noticed on the Byelaya river as far as Angasyak, as also in the north of the Kama at the town of Laishev, and in the lower parts of the Mesha river. It is thus certain that a gulf of the Caspian Sea penetrated up the valley of the Volga and its tributaries as far as 55° 23' of northern latitude, and that the upper parts of this gulf contained a water less salt than that of the Caspian Sea. It is very difficult to ascertain whether the deposits just mentioned belong to the later parts of the Pliocene period, or to the earlier parts of the Post-Pliocene, and Russian geologists are divided upon this point. But the Kazan authors point out the absolute identity of the fossil species of *Adacna*, *Cardium*, *Dreissena*, *Didacna*, and *Hydrobia*, with those now living in the Caspian Sea; while the discovery in a fossil state of a species of *Corbicula*, and Prof. Sintsoff's *Hydrobia novorossica*, which are not met with now in the Caspian Sea, is not considered as sufficiently proving the greater antiquity of the Kama deposits. Part of these deposits have been denuded by the rivers and mixed with the above-mentioned loess.

OUR ASTRONOMICAL COLUMN.

PERIHELIA OF COMETS.—In *Astronomische Nachrichten*, No. 3005, Dr. Holetschek discusses the apparent connection between the heliocentric longitudes of comet perihelia and the heliocentric longitude of the earth at the times of their perihelion passages. It is evident that any one comet appears brightest when its *perihelion* passage occurs at the same time as that of *perigee*. The possibility of discovering and observing comets decreases, therefore, with the increase of the arc contained between the heliocentric longitudes (*l*) of comet perihelia and the heliocentric longitude (*L*) of the earth during the perihelia.

Dr. Holetschek has tabulated the value of $(l - L \pm 180^\circ)$ for every known comet, and the values obtained are as follows:—

$(l - L \pm 180^\circ)$	Number of elliptic comets.	Number of parabolic comets.	Total number with perihelion distances greater than 0.3 .
0° to 30° ...	16	90	106
30° „ 60° ...	10	45	55
60° „ 90° ...	3	46	49
90° „ 120° ...	2	26	28
120° „ 150° ...	—	21	21
150° „ 180° ...	—	22	22
Total ...	31	250	281

It will be seen that the majority of all the known comets have the longitude of their perihelion at a small angular distance from that of the earth. This grouping is especially well marked in the case of elliptic comets of short period. The following table exhibits the results found for comets with perihelion distances less than 0.3 times the mean distance of the earth from the sun:—

$l - L$	Number of parabolic comets.
0° to 60° ...	19
60° „ 120° ...	10
120° „ 180° ...	7
Total ...	36

Another interesting result brought out by Dr. Holetschek's investigations is that the positive sign occurs with very nearly the same frequency as the negative sign in the angle $l - L \pm 180^\circ$. This indicates that the perihelion points, when reduced to the ecliptic, lie, with equal frequency, in front of and behind the earth.

Mr. W. E. Plummer points out, in this month's *Observatory*, that the cause of the abnormal distribution exhibited by comets whose orbits are greatly inclined to the elliptic has still to be explained.

GASEOUS ILLUMINANTS.

I.

THE autumn course of Cantor Lectures at the Society of Arts was delivered by Prof. Lewes, who, after discussing the nature of various gases capable of burning with luminosity, gave a review of the theories which have been advanced to explain the light-giving power of certain flames.

Sir Humphry Davy first propounded his theory that the cause of luminosity in ordinary flames was the incandescence of nascent carbon—a theory which was accepted as the true one until the researches of Dr. Frankland in 1868, on the effect of pressure on non-luminous flames, showed that, under certain circumstances never likely to arise in a gas-flame, luminosity might be due to other causes. Later observers have shown that luminosity in a flame is to a great extent affected by temperature. These factors, though of the greatest importance, do not affect the truth of the original theory.

In the *Philosophical Transactions* for 1817, Sir Humphry Davy says, while alluding to a paper published in one of the early numbers of the *Journal of Science and Arts*: “I have given an account of some new results on flame, which show that the intensity of the light of flames depends principally upon the production and ignition of solid matter in combustion.”

This definition, however, has been gradually altered until it is more often stated that “the presence of solid particles suspended in the flame (or in immediate contact with the burning gas) is essential to its luminosity”—an idea which Davy never had, as is shown by him later in the paper defining flame as follows: “Flame is gaseous matter heated so highly as to be luminous;” and again: “When, in flames, pure gaseous matter is burnt, the light is extremely feeble.” Moreover, he alludes to “common flames”—evidently meaning the flames of candles, lamps, or gas; in all of which cases I think it can be proved beyond a doubt that his theory, as expounded by himself, was perfectly correct.

On June 11, 1868, Prof. E. Frankland read a communication before the Royal Society, in which he described experiments which led him to doubt Sir Humphry Davy's theory. He

points out that the deposit of soot formed when a cold surface is held in a gas or candle flame is not pure carbon, but contains hydrogen, which can only be got rid of by prolonged heating in an atmosphere of chlorine. Also that many flames possessing a high degree of luminosity cannot possibly contain solid particles. Arsenic burnt in oxygen gives a bright white light; yet as arsenic volatilizes at 180°C. , and the arsenic trioxide forms at 218°C. , it is evident that at the temperature of incandescence (which is at least 500°C.) there can be no solids, but simply vapours present in the flame; and for the same reason, the intense light resulting from the burning of phosphorus in oxygen cannot be explained by the solid particle theory. From these results, Dr. Frankland considers that “incandescent particles of carbon are not the source of light in gas and candle flames, but that the luminosity of these flames is due to radiations from dense but transparent hydrocarbon vapours;” and he further shows that non-luminous flames, such as that produced by carbon monoxide and hydrogen, can, when burning in an atmosphere of oxygen, be rendered luminous if the ordinary atmospheric pressure is increased to 10 atmospheres, so as to prevent or retard as far as possible expansion during combustion. From Dr. Frankland's experiments, there is no doubt that the luminosity of a flame is increased by pressing around it the atmosphere in which it is burning, and also that rarefaction has the opposite effect—a point also worked at by Davy; but his experiments do not show that incandescent particles of carbon are not the principal source of luminosity in a gas-flame. He also shows that, the higher the density of the vapours present in a flame, the more likely it is to be luminous.

In 1874, Soret attempted to demonstrate the existence of solid particles in a luminous hydrocarbon flame, by focussing the sun's rays on the flame, and examining the reflected light by means of a Nicol prism; but neither his research nor that of Burch, who repeated his experiments, using the spectroscope instead of the prism, showed more than that solid particles are present. Herr W. Stein, in considering Dr. Frankland's objections to Davy's theory, pointed out that the soot which is deposited from a candle or gas flame, and which Frankland looked upon as a condensed hydrocarbon, contains 99.1 per cent. of carbon and only 0.9 per cent. of hydrogen, which is about the quantity of hydrogen one would expect to be occluded by carbon formed under these conditions, and he also pointed out that if the soot were a heavy hydrocarbon condensed by a cold surface, cooling the vapour present in the flame, it ought to again become volatile at a high temperature, which it does not. The next steps in the controversy were the attempts made by Hilgard, Landolt, and Blochman, to trace the actions taking place in various flames by withdrawing the gases from different parts of the flame and determining their composition.

The experiments so made show that of the ordinary constituents of the gas the hydrogen is the first to burn, as one would expect from its relatively low igniting point and great rapidity of combustion. The burning of the carbon monoxide cannot be traced in the same way, as it is formed more rapidly (by the incomplete combustion of the marsh gas) than it burns, so that a steady increase in the proportion present takes place while the marsh gas steadily burns away, until a height of $1\frac{1}{2}$ inches is attained, when its combustion becomes very rapid. Practically the illuminants do not undergo any change at first—indeed, they slightly increase in quantity from the decomposition by heat of some of the marsh gas into acetylene. They only begin to decompose at a height of $1\frac{1}{2}$ inches above the orifice of the burner; and then burn rapidly in the highest part of the flame. Moreover, a most important fact to be noted is that at the height of $1\frac{1}{2}$ inches there is a sudden rise in the quantity of carbon monoxide at the moment that the illuminating olefines begin to disappear—a result undoubtedly due to the action of the nascent ignited carbon on carbon dioxide.

The illuminants in the flame consist of various hydrocarbon gases and vapours which in the lower part of the flame are reduced by the heat to simpler hydrocarbons, and finally in the luminous zone become decomposed to methane and carbon; and it is the carbon in excessively minute particles which at the moment of liberation is heated to incandescence, and “principally” gives the light of the flame—the marsh gas originally present, and also that formed from the heavier hydrocarbons, adding its quota to the luminosity by still further decomposition during combustion, and finally becoming carbon dioxide and water. In 1876, Dr. Karl Heumann made a most important contribution to the theory of luminous flames in some papers